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ABSTRACT

A study examined the extent to which postsecondary institutions in Indiana, Kentucky, and Ohio were addressing the needs of industry for those individuals desiring to enter the field of manufacturing engineering technology. The population for the study included all those schools in the three target states that were identified by a directory compiled by the Society of Manufacturing Engineers as having programs in manufacturing engineering. Current catalogs were obtained for each institution in the sample, and courses of study listed in these publications were analyzed and categorized. Institutions having Accreditation Board for Engineering and Technology (ABET) certification were compared to non-accredited institutions. A majority of both ABET-accredited and non-accredited programs required courses in introductory computer programming, statistics, technical mathematics, physics, English composition and speech, and economics. With respect to technical courses, every institution in the population sample placed the highest value on courses in manufacturing materials and processes and technical drawing. Of the accredited schools, 83 percent required a senior project as opposed to only 43 percent of the non-accredited schools. It was concluded that a high degree of freedom exists in developing curricula designed to prepare manufacturing engineering professionals and to contribute to their continued growth. (MN)

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AN ANALYSIS OF MANUFACTURING ENGINEERING TECHNOLOGY PROGRAMS THROUGHOUT INDIANA, KENTUCKY, AND OHIO

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INTRODUCTION

> "Manufacturing engineering is that specialty of professional engineering which requires such education and experience as is necessary to understand, apply and control engineering procedures in manufacturing processes and methods of production of industrial commodities and products; and requires the ability to plan the practices of manufacturing, to research and develop the tools, processes, machines and equipment, and to integrate the facilities and systems for producing quality products with optimal expenditure."

From the above cited definition of manufacturing engineering, it is axiomatic that individuals representative of this professional group may be employed having a multitude of job descriptions while classified under one generic identity.

The worldwide need and the extent to which this nation is meeting its own demand for competent engineers and technologists in manufacturing is a shared concern among many leaders in industry, learned societies, and government. Correlated to this concern is the challenge confronting these professionals individually as their roles and responsibilities change. These changes occur largely through technological innovations whereby new materials and processes are developed in an effort to improve productivity and safeguard the diminishing resources of natural energy.

While manufacturing engineering technology may present many challenges to industry, government, and education, not the least of these are curriculum concerns as is evidenced by current articles found in various professional journals.

Predictions made in 1977 included:

1980--There will be a shortage of skilled personnel to service computer-controlled automatic assembly equipment.

1983--Computer-aided design of ECM tooling and of EDM tooling will become a reality.

Energy shortages will expand the use of room-temperature curing adhesives, replacing the majority of heat-curing systems such as epoxies.

1985--Software systems will be available which will accurately predict the manufacturing cost based on part definition only.

Twenty percent of the direct labor in automobile final assembly will be replaced by programmable automation.

1987--Approximately forty percent of the equipment failures will be instantaneously detected and diagnosed with on-line software.

1988--Fifty percent of the direct labor in small component assembly will be replaced by programmable automation.

1990--The development of sensory techniques will enable robots to approximate human capabilities in assembly. (SME, 1977)

The range in years of these predictions may be noted to be from three to thirteen, yet the realities have far outpaced the projections. The 1990 prediction regarding robots is somewhat obsolete inasmuch as the precision capability of some robots is far beyond human performance in both eye and hand sensory limits.

Based on a major nationwide study sponsored by the Society of Manufacturing Engineers, it was stated as one of several highlights that:

> "As new techniques of production are introduced, the job duties and responsibilities of manufacturing engineers are shifting and broadening. Concomitantly, the educational needs and professional concerns of manufacturing engineers are changing." (SME, 1980)

At a National Manufacturing Education Forum, the Chairman of the SME International Education Committee, Dr. Jerald A. Griess, stated:

> "Using manufacturing education as a vital tool to improve productivity is a challenge facing both industry and educators with teamwork and cooperation as key ingredients for successful activities to be developed." (SME, 1980)

In announcing a study by the National Academy of Engineering, Dr. H. Guyford Stever, Chairman of the Assembly of Engineering of the National Research Council stated:

> "We have been discussing for more than a year this nation's declining rate of productivity and reduction in innovation capacity. These relate to manufacturing technology, which is today experiencing a new surge. It is not only computer-aided manufacturing, but robotics, new processes, and new energy-conserving technology. Many companies that I know of have organized specific operations in manufacturing technology. The Congress is concerned with it. In engineering schools, it is making a comeback as the subject of vital importance. (SME, 1980)

An appeal must be made to all industrialists and educators at various levels to examine their roles in preparing today's youth for challenging careers, as part of a team effort, whose mission is to provide career information and updated curriculums that are second to none.

In the time span of this report, it is not feasible to dwell upon each of the issues and concerns identified. Needed as it might be, such a compilation would require data from many sources and a great deal of computer time in order to treat statistically the data collected. What can be studied, however, is the preparation of manufacturing engineers and technologists based on current curriculums. This, then, is the thrust of this report: An Analysis of Manufacturing Engineering Technology Programs Throughout Indiana, Kentucky, and Ohio.

It is sincerely hoped these findings will prove to be of value to counselors, curriculum designers, industrialists, and our nation's most precious asset--our students--who offer the promise for tomorrow.

PURPOSE OF THE STUDY

In an effort to provide assistance to school counselors through the availability of career information and course-work identities, to help those educators involved in curriculum revision or expansion, and to reveal to industrial personnel the ongoing preparatory strategies currently found in postsecondary institutions, the need for this study was recognized.

STATEMENT OF THE PROBLEM

The problem of this study was to determine the extent to which postsecondary institutions were addressing the needs of industry for those people desirous of entering the field of manufacturing engineering technology. More specifically, it was the intent of the writer to provide insight into the following:

1. To what extent are existing curriculums focused upon the predictions made by industrial leaders?
2. How do curriculums of schools accredited by the Accreditation Board for Engineering and Technology compare to non-accredited institutions?
3. What degree of agreement exists among these schools within each group?
4. What values are placed on courses of study for both technical and non-technical categories?

PROCEDURES

From the Directory of Colleges, Universities, and Technical Institutes, compiled by the Society of Manufacturining Engineers, institutions throughout Indiana, Kentucky, and Ohio, having programs in Manufacturing Engineering, were identified. This source also revealed those institutions having accreditation granted by the Accreditation Board for Engineering and Technology (ABET).

Current catalogs were obtained from each institution comprising the population sample, and courses of study listed in these publications were analyzed and categorized. Categories employed reflect the areas of study described by ABET.

In a few instances, a subjective decision was made in order to locate a unique course within a specific category. This problem was to be expected when dealing with academic studies of this magnitude, designed for the preparation of engineers and technologists. Any clarification needed was readily available through personal contacts representing these institutions.

Since most institutions granted semester-hour credit, quarter-hour credit from other institutions was converted; thus, all values recorded denote semester-hours to the nearest integer.

ANALYSIS OF FOUR-YEAR CURRICULUMS

The analysis of the curriculums resulted in the following subject categories with corresponding tables.

Mathematics, Table 1

Science, Table 2

Communications, Table 3

Humanities/Social Sciences, Table 4

Physical Education/Military Science/Health, Table 5

Other Non-Technical Courses, Table 6

Technical Courses, Table 7

Cooperative Internships/Senior Projects, Table 8

Table 9 is a composite of the above categories comparing the means of semester hours required in ABET-accredited curriculums with those of non-accredited curriculums.

In Tables 1 through 8, those institutions having ABET-accredited programs are identified with a superscript (^{a}) while those institutions having non-accredited programs are recognized with a superscript (^{n}).

The balance of semester hours required for a baccalaureate degree reflect those semester hours of credit to be earned in general or restrictive electives and are not included in these tables.

In Table 1, a study of the percentage column for accredited programs identifies Computer/Programming as the only course in the Mathematics category being required in all institutions. Among institutions having non-accredited programs, this same course of study received the highest value of required semester hours.

The course deemed second in importance for each institutional classification is observed to be Statistics.

While the third highest ranking course for both institutional classifications is noted to be Technical Mathematics, it is this course where the greatest number of semester hours is recorded by one institution. This is identified in the Range column as being nine semester hours at an institution having an accredited program.

Algebra and a combined course in Analytic Geometry and Calculus were both ranked as being the least in importance. No accredited program required these courses, and only 14 percent of non-accredited programs included these as required studies.

Of the total number of semester hours required in Mathematics, a variation was seen to exist, ranging from six hours in a non-accredited program to 22 semester hours in an institution operating an accredited program.

TABLE 1. SEMESTER HOURS REQUIRED IN MATHEMATICS

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Pre-Algebra,-Trig.,-Calculus				5										17		0-5
Algebra		3													14	0-3
Trigonometry												3		17		0-3
Algebra & Trigonometry					5	5		5		4				33	28	0-5
Analytic Geometry & Calculus									3						14	0-3
Calculus								6			6	3		33	14	0-6
Computer/Programming		3	3	3	3		3	3	3	3	3	3	3	100	71	0-3
Statistics			3	3	3		3		3	3	4	2	3	83	57	0-4
Technical Mathematics			6		1		7		3				9	50	28	0-9
Calculus for Technology			6		6									33		0-6
Engineering Analysis											2		7	17	14	0-7
Logic							3	3						17	14	0-3
Other	7					3								28		0-7
Total	7	6	18	11	18	8	16	17	12	10	15	11	22			6-22

A comparison of accredited and non-accredited programs for each course of study in Science reveals solidarity among institutions offering accredited programs for Physics. With 100 percent of these institutions requiring Physics, and all but one non-accredited program requiring at least one such course, Physics is ranked uppermost in importance in the field of science. This holds true for both frequency and the highest Range value, shown in Table 2.

The second highest value of importance is placed upon Chemistry in the number of institutions requiring this course, as well as the number of semester hours required.

Although the least number of required hours credit recorded may be found in both institutional classifications, it is at an institution having a non-accredited program where the greatest number of semester hours are required for the Science category.

Thus, the widespread range is attributed to institutions offering non-accredited programs.

A further study of the total number of required hours for this category shows accredited institutions to have a variation from seven to 14 semester hours.

ABLE 2. SEMESTER HOURS REQUIRED IN SCIENCE

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
hysics		8	8	8	4	10	8	8	7	10	8	7	8	100	86	0-10
hemistry			3				4	4		5	8	7		50	43	0-8
ther or Above Elective	7	3			3	3					6			17	57	0-7
otal	7	11	11	8	7	13	12	12	7	15	22	14	8			7-22

An analysis of the percentage column of Table 3 shows non-accredited institutions requiring only 50 percent of the courses making up this category.

English Composition was noted to be the top-ranked course for both accredited and non-accredited programs. Only one institution in each classification did not require such a course. In the case of the non-accredited institution not requiring English Composition, this same institution failed to require any course in the Communications category. For the one accredited program not requiring the standard English Composition course, a composition course structured for engineers and technologists is required, and this is listed as Technical Writing.

The weight given Speech by both classes of institutions places this course in the second highest rank of importance for the Communications category. In addition to the regular Speech requirement, 50 percent of the accredited programs required a second course listed as Technical Speech.

With more than 60 percent of all institutions requiring Technical Writing, this course ranked third in importance.

Developmental Reading is observed to be viewed as the least important in this category, being required by only two accredited institutions for one semester hour credit in each case.

TABLE 3. SEMESTER HOURS REQUIRED IN COMMUNICATIONS (WRITTEN/ORAL)

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
English Composition	5	6	3	3	3		6	6	3	6	3		2	83	86	0-6
Speech	3	2	3	3	3				5	3	3	2		67	71	0-5
Literature	3							3	3		3			17	43	0-3
Technical Writing			6	6	3				3	3	2	2		67	43	0-6
Technical Speech			3	3	3									50		0-3
Developmental Reading				1									1	33		0-1
Elective				3									2	33		0-3
Reading/Writing/Speaking													5	17		0-5
Total	11	8	15	19	12		6	9	14	12	11	4	10			0-19

A study of Table 4 shows a relatively high degree of freedom in electing courses of study comprising the category of Humanities and Social Sciences. This is noted in the highest recorded percentages of accredited and non-accredited programs and depicts the greatest number of required semester hours.

Among specifically-cited courses of study within this category, Economics is observed to be valued as the highest in importance.

Although Psychology is ranked next in importance by the population sample, only one accredited institution required this course.

Human Relations, on the other hand, carried twice the weight as did Psychology among accredited institutions but ranked the least in importance according to the population sample.

History and Labor Economics were viewed as having identical values, both in frequency and range, with only one program in each institutional classification requiring these courses.

The observed range of six to 22 semester hours required is attributed to offerings in accredited institutions.

TABLE 4. SEMESTER HOURS REQUIRED IN HUMANITIES AND SOCIAL SCIENCES

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Economics	6	3	3	3	3	3			3	3	6	4		67	86	0-6
History							6	3						17	14	0-6
Psychology	6						3		3	3		3		17	57	0-6
Sociology							3		3				8	17	28	0-8
Labor Economics		6	3											17	14	0-6
Human Relations			3	3										33		0-3
Elective	8	13	3		6	15	9	19	3		6	8	5	83	86	0-19
Total	20	22	12	6	9	18	21	22	12	6	12	15	13			6-22

An examination of Table 5 shows that Physical Education, Military Science, and Health is the second smallest category of the Manufacturing Engineering Curriculum.

Of those institutions requiring credit earned in this area, only one institution permitted overall electives.

As a specific requirement, Physical Education ranked highest with 30 percent of the population sample including this course as a baccalaureate degree requirement. This was based on 57 percent of institutions having non-accredited programs; thus, no accredited program required such a course.

The next highest ranking of courses in this category was observed to be found in the election of either R.O.T.C. or Physical Education. This option on required electives accounted for the greatest number of required semester hours in the category.

Health required in one institution and a single two-semester hour elective within the category required by another institution placed these items as being the least in importance.

A study of the total semester hours required revealed that Physical Education, Military Science, and Health are not required by 54 percent of the population sample.

TABLE 5. SEMESTER HOURS REQUIRED IN PHYSICAL EDUCATION, MILITARY SCIENCE, AND HEALTH

Course	Institution														Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[s]	%[a]	%[n]	
Physical Education	4	2			2				2						57	0-4
R.O.T.C. or Phys. Ed.					8								2	17	14	0-8
Health					2										14	0-2
Elective								2						17		0-2
Total	4	2			12			2	2				2			0-12

The highest ranking course of a non-technical nature in Table 6 is identified as Orientation. This career-oriented course for engineers and technologists was required by almost 70 percent of the population sample.

The next highest ranked course was in Industrial Organization/Functions. It was here that a higher degree of agreement existed between accredited institutions and non-accredited institutions.

The area of study having the least importance assigned was that of Job Evaluation, where only one institution was found to require such a course and the credit earned was limited to two semester hours.

The next least valued courses of study observed were Research and Development, Law, and Conference Leadership. These three courses were required by only one institution in each case, and these requirements represented both types of institutions.

The widespread range of this category, shown to be from three to 45 semester hours, reflects varying values among institutions having accredited programs, inasmuch as the range among non-accredited institutions may be observed as being 11 to 29 total semester hours required.

TABLE 6. SEMESTER HOURS REQUIRED IN OTHER NON-TECHNICAL COURSES

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Orientation		2		3	1	1	1	1	2	1	1			50	86	0-3
Occupational Safety & Health	3						3			2					43	0-3
Engrg. Management Decisions					3		3				3			17	28	0-3
Manufacturing Management		6				12	3			2	6	3		17	71	0-12
Plant Layout/Matl. Handling		3	6				3			3		2		33	43	0-6
Industrial Supervision		3		3	3		3				3	2		50	43	0-3
Technical Seminar	3				3		1							17	28	0-3
Production Planning/Control	3	3	6				3			3		3		33	57	0-6
Work Measurement		3	6				3		3	3				17	57	0-6
Quality Control		3	8				3		3	3	3			17	71	0-8
Engrg. Cost Analysis			6	3				3		2	3			50	28	0-6
Conference Leadership		3													14	0-3
Industrial Organ./Functions	3	3	3	3	3					3			3	67	43	0-3

TABLE 5. SEMESTER HOURS REQUIRED IN OTHER NON-TECHNICAL COURSES (continued)

Course	Institution															Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	%[a]	%[n]	
Research & Development	3														14	0-3
Accounting			3							3	3	3		33	28	0-3
Law			3											17		
Job Evaluation			2											17		0-2
Visual Communications			2						3					17	14	0-3
Total	15	29	45	12	13	13	26	4	11	25	22	13	3			3-45

A study of Table 7 presents two areas of course work on which accredited and non-accredited institutions are in agreement. These areas are (1) Manufacturing Materials and Processes and (2) Technical Drawing. Every institution in the population sample required courses from these two areas.

Of these courses, Manufacturing Materials and Processes is ranked the highest in value, with the population sample requiring a total of 91 semester hours.

The next highest ranked course is noted to be Technical Drawing, where a total of 63 semester hours is required by the population sample.

The least valued course was noted to be Woods, where one accredited program required a two-semester hour course in this area.

The next lowest value of importance is observed in Engineering Geometry and Graphics, Construction, Metal Fabrication and Mfg./Machine Tool Operations. These four courses were required by only one institution in each case, with three semester hours being awarded to each course.

As was noted in several other tables, the widespread range is attributed to the greater variation found to exist among institutions offering accredited programs.

TABLE 7. SEMESTER HOURS REQUIRED IN TECHNICAL COURSES

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Technical Drawing	3	4	6	6	6	3	3	6	3	7	4	6	6	100	100	3-7
Fluid Power		3		6	3		3	4		2			3	67	43	0-6
Electrical Systems				4			3	3						33	14	0-4
Mfg./Machine Tool Operations							3								14	0-3
Statics for Technology				2	3		3	3			3		3	67	28	0-3
Strength of Materials				4	4		3	4	3		3		6	67	43	0-6
Mfg. Matls. & Processes	6	6	6	4	12	6	6	6	11	10	11	2	5	100	100	2-12
Machine/Tool & Die Design							3	3	3		5		8	33	43	0-8
N.C. & Comp. Asst. Mfg.					3	3					6			17	28	0-6
Machine Shop	3						3	3		3		3	2	50	43	0-3
Engrg. Geometry & Graphics								3						17		0-3
Heat-Power				3	6			3		3			8	67	14	0-8
Dynamics (kinematics)					2			2		2			3	50	14	0-3

TABLE 7. SEMESTER HOURS REQUIRED IN TECHNICAL COURSES (continued)

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Electronics & Instrumentation				3	3			3	5		5		3	67	28	0-5
Plastics Technology	3	3										4		17	28	0-3
Electricity/Electronics	4	4				3				7	5	5	7	33	71	0-7
Power				3		3						3		33	14	0-3
Woods												2		17		0-2
Graphic Arts												4		17		0-4
Foundry/Welding										2		2		17	14	0-2
Hydraulics												2	3	33		0-3
Machine Elements				4	3									33		0-4
Construction									3						14	0-3
Metal Fabrication												3		17		0-3
Total	19	20	12	39	45	18	30	43	28	36	42	36	57			12-57

Giving attention to Table 8, it is observed this is the smallest category identified in the Manufacturing Engineering Technology curriculum.

Examination of data shows the Senior Project course to be by far the most valued of the two courses.

Of those institutions having the Senior Project requirement, only 25 percent awarded less than three semester hours credit for this area.

Although 70 percent of the population sample saw value in the two courses, it was the accredited institutions weighing heavily for the Senior Project approach.

TABLE 8. SEMESTER HOURS REQUIRED IN COOPERATIVE INTERNSHIPS AND SENIOR PROJECTS

Course	Institution													%	%	Range
	A[n]	B[n]	C[a]	D[a]	E[a]	F[n]	G[n]	H[a]	I[n]	J[n]	K[n]	L[a]	M[a]	[a]	[n]	
Cooperative Internship									10						14	0-10
Senior Project	1	1	4	4	4			3		4			3	83	43	0-4
Total	1	1	4	4	4			3	10	4			3			0-10

An overview of the importance given each category is realized in studying the semester-hour means of accredited and non-accredited programs shown in Table 9.

Both groups showed agreement on the category Technical Courses as having the highest amount of importance. Even with this category recognized as being ranked the highest, the accredited institutions differed from the non-accredited institutions by requiring 11 additional semester hours.

A close relationship between accredited and non-accredited programs was also noted in the values placed upon the two lowest categories. These were observed to be (1) Physical Education, Military Science, and Health, and (2) Cooperative Internships and Senior Projects.

For the most part, only a one-course variation existed among other categories when comparing the two institutional classifications.

TABLE 9. MEANS OF SEMESTER HOURS REQUIRED

Category	ABET-Accredited Programs	Non-Accredited Programs
Mathematics	16	11
Science	10	13
Communications	12	9
Humanities & Social Sciences	13	16
Physical Education, Military Science, and Health	1	3
Other Non-Technical Courses	15	20
Technical Courses	39	28
Cooperative Internships and Senior Projects	3	2
Σ of Means	109	102

SUMMARY AND CONCLUSIONS

Summary

From the most recent definition of manufacturing engineering, formulated by the Society of Manufacturing Engineers and adopted by its Board of Directors in 1978, elements may be identified having an impact on the design of the curriculum intended to produce competent professionals who will be challenged by tomorrow's technology.

Data available today from many reliable resources, such as the Society of Manufacturing Engineers' Delphi Forecast, SME's Battelle Study, noted industrialists, and the nation's White House, identify the growing demand for manufacturing engineers and technologists, and these data reflect and predict a continued shortage in trained personnel. Other well-founded predictions of a technical nature are similarly made in coping with the need to improve productivity.

To what extent are the colleges, universities, and technical institutes meeting the current and projected needs was the underlying thrust of this study, with a focus concentrated on existing curriculum.

Institutions offering such programs throughout Indiana, Kentucky, and Ohio were identified from the Directory of Colleges, Universities, and Technical Institutes compiled by the Society of Manufacturing Engineers.

Published catalogs were obtained from these institutions, and these provided the curriculum information needed for the study.

All courses of study were categorized and semester-hour requirements were recorded for each subject. Institutions having ABET-accredited programs were compared to non-accredited institutions, and the value of importance was determined for each category and courses within categories.

Conclusions

1. A course in the Introduction to Computers/Programming is required in all ABET-accredited institutions and in almost three-fourths of non-accredited institutions.
2. Statistics and Technical Mathematics are both held in high esteem as required subjects.
3. Even among accredited programs, Calculus was not valued highly as a requirement.
4. All accredited programs include Physics as a requirement, and 86 percent of non-accredited institutions similarly considered this subject to be the most important in the field of science.
5. In the area of Communications, English Composition and Speech are viewed highly, with a majority of accredited institutions also requiring a course in Technical Writing.
6. A course in Economics was ranked highest in importance in the category of Humanities and Social Sciences.

7. Less than one-half of the population sample considered Physical Education, Military Science, and Health to have much value in this program.
8. A major portion of institutions involved in this study required a career-oriented course titled Orientation. In this same non-technical category, Industrial Organization/Functions outranked the remaining non-technical courses in value of importance.
9. Every institution in the population sample placed the highest value among technical courses upon (1) Manufacturing Materials and Processes and (2) Technical Drawing.
10. With 83 percent of accredited institutions requiring a course in Senior Project, these institutions viewed this area of study with a higher value than did their counterparts where 43 percent have such a requirement.
11. Both accreditied and non-accredited institutions rank Technical Courses as being the category of highest value.
12. There is to be found both agreement and variation on required courses and the amount of credit granted between accredited and non-accredited institutions, as well as within each classification. This would suggest a high degree of freedom exists in developing a curriculum designed to prepare manufacturing engineering professionals and to contribute to their continued growth.

RECOMMENDED READINGS

College, University, and Technical Institute Catalogs, current issues.

Greene, Alice M., "Training the Next Generation of Manufacturers," Iron Age, pp.62-65, January 22, 1982.

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SME, Directory of Colleges, Universities, and Technical Institutes, Dearborn, MI, 1984.

SME, For Manufacturing Engineering Educators: FYI, quarterly publications, Dearborn, MI, 1977 to current issue.

The White House, "Fact Sheet: The President's Industrial Innovation Iniatives," Washington, D.C., 1979.

Worthley, Warren W., Summary Evaluation of ECPD Accredited Baccalaureate Manufacturing (Engineering) Technology Programs, Technical Paper MM78-968, SME, Dearborn,MI, 1978.

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